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First Results from the Fennoscandian GPS Networks

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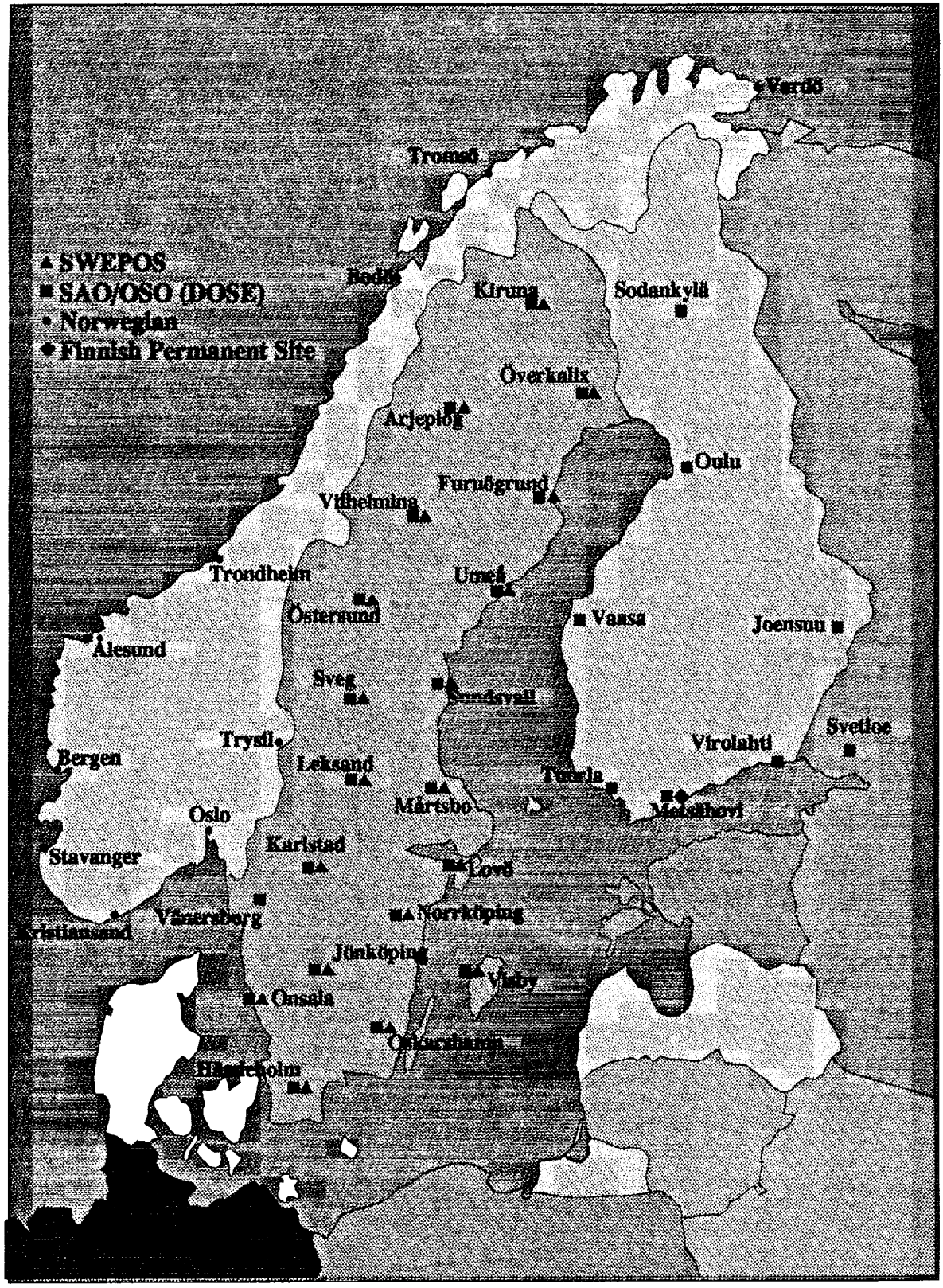
1993 AGU Fall Meeting


▲ SWEPOS
■ SAO/OSO (DOSE)
• Norwegian
◆ Finnish Permanent Site
Vardö
Tromsö
Kiruna
Sodankylä
Överkalix
Arjeplog
Oulu
Furuögrund
Vilhelmina
Trondheim
Umeå
Östersund
Vaasa
Joensuu
Ålesund
Sveg
Sundsvall
Svetloe
Vtrolahti
Trysil
Bergen
Leksand
Tavsla
Mårtsbo
Oslo
Karlstad
Stavanger
Lovö
Västeraborg
Norrköping
Jönköping
Visby
Onsala
Stockholm

The Swedish Permanent GPS Network for Positioning (SWEPOS)

Collaborative effort between:

The National Land Survey of Sweden
Onsala Space Observatory
Smithsonian Astrophysical Observatory

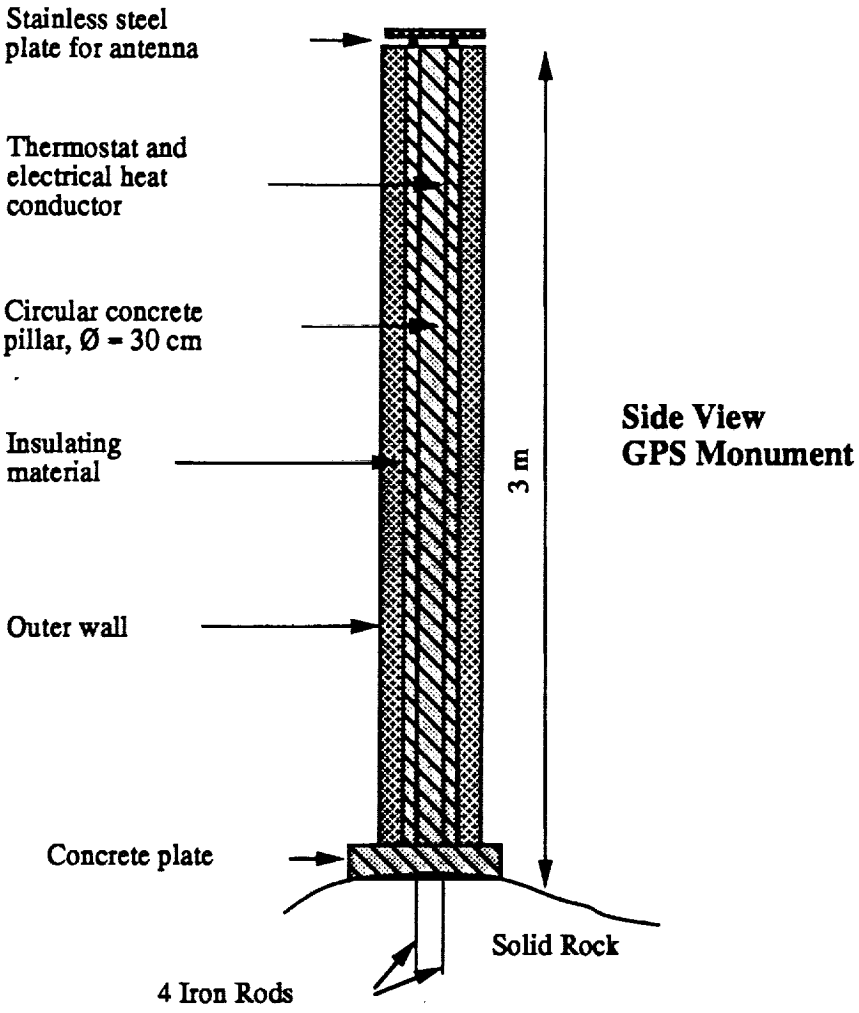
Applications

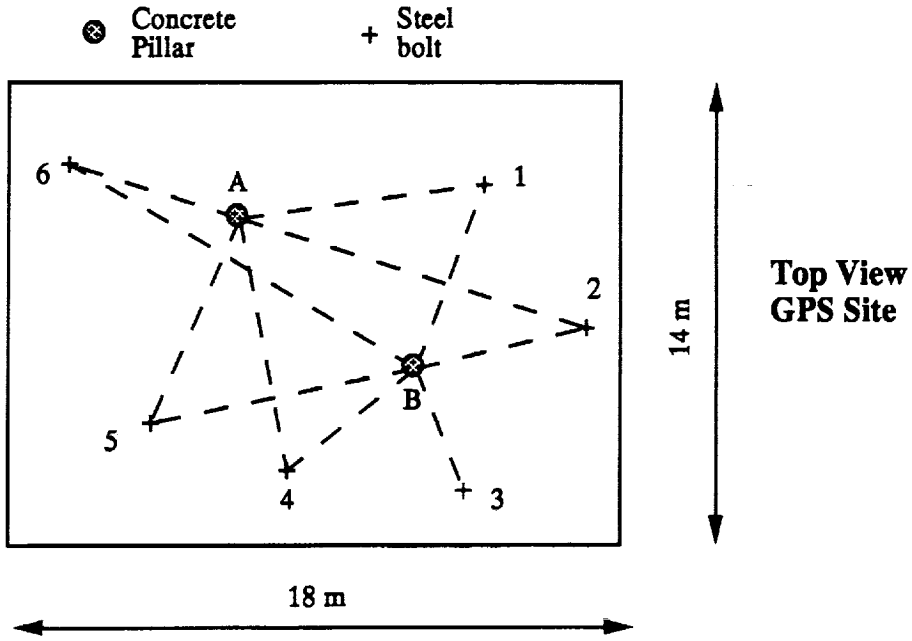
Real-Time Navigation

"Low accuracy" positioning

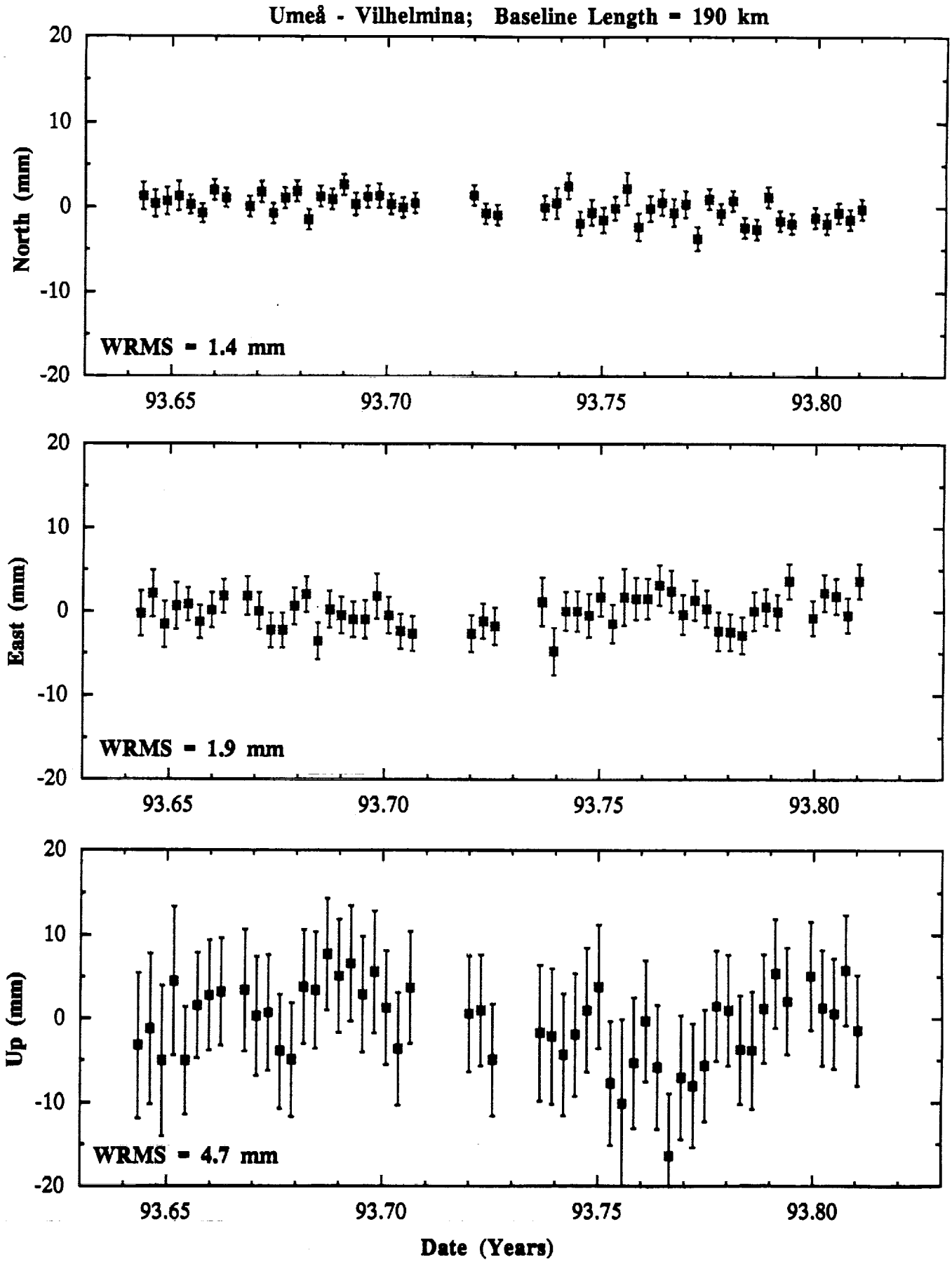
Surveying

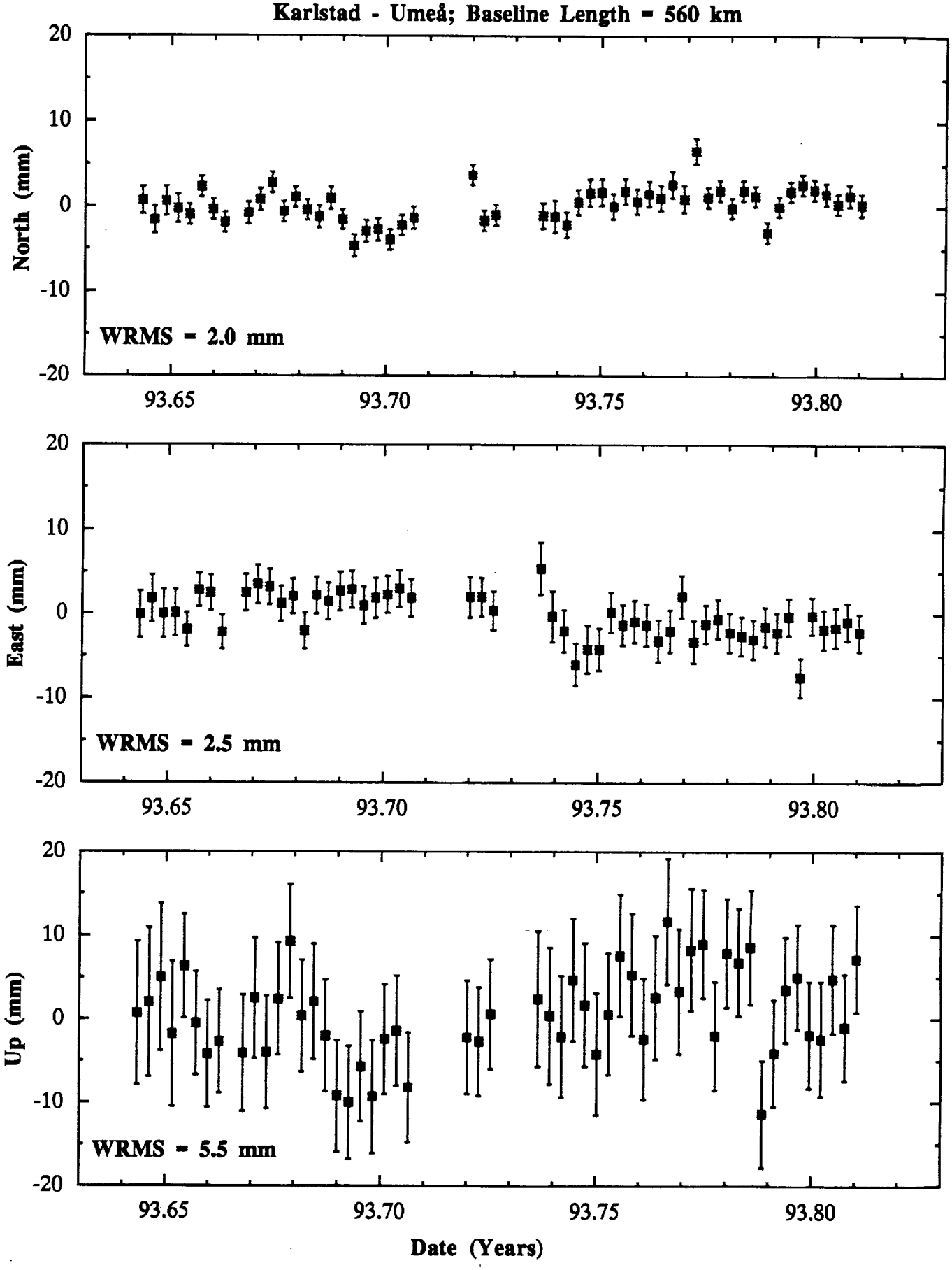
Geophysical applications, e.g., Postglacial rebound and correction of tide gauge data (SAO, OSO, U. Toronto)





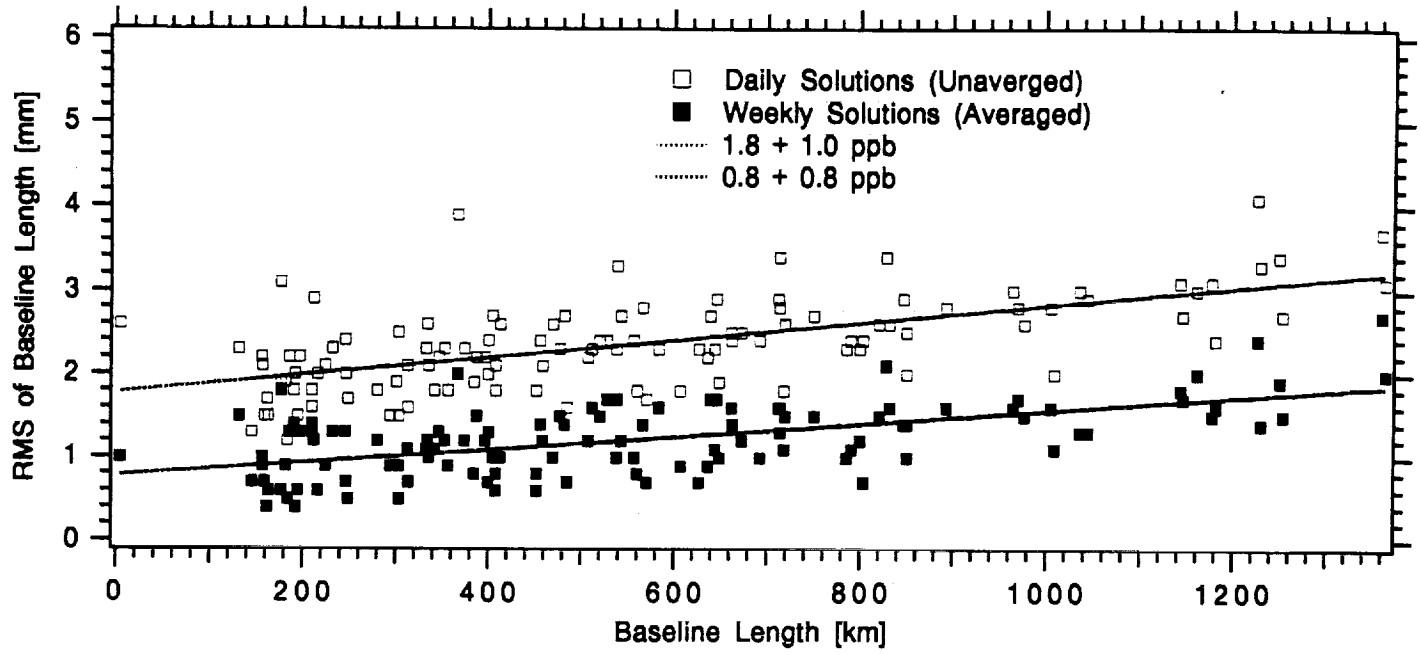
The Local Control Network at Esrange

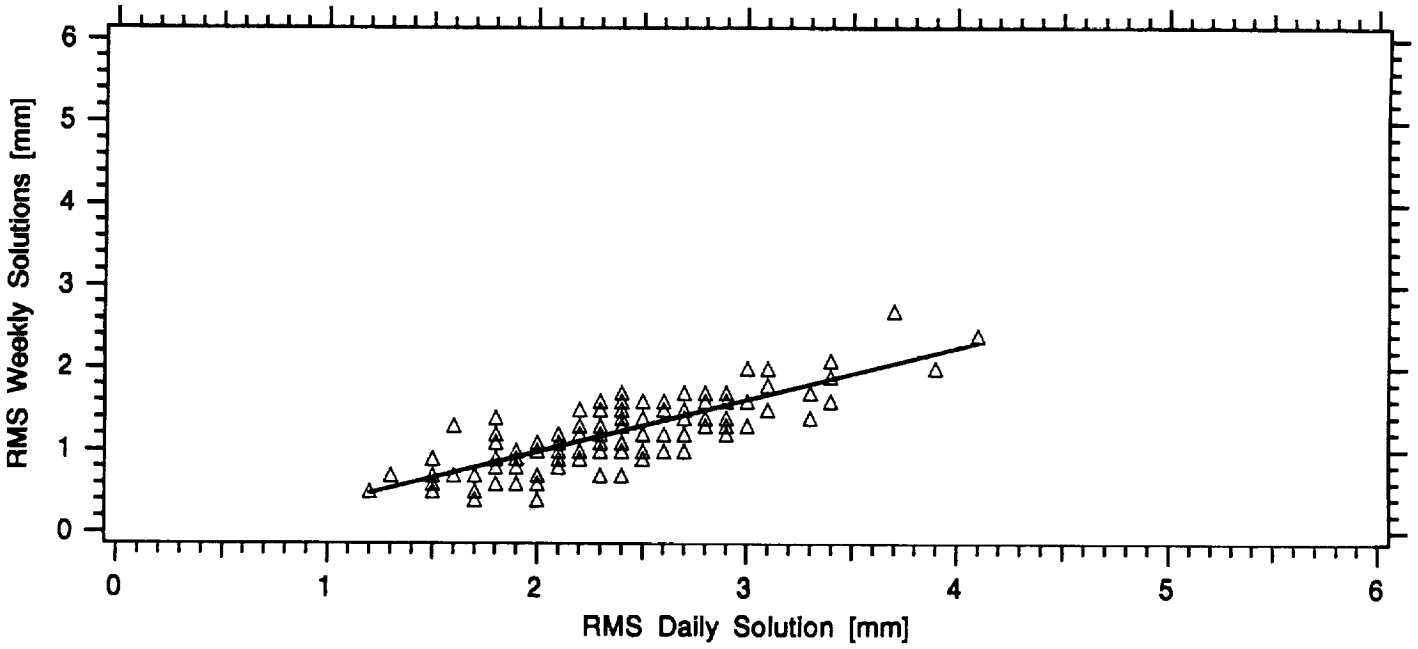

Umeå - Vilhelmina; Baseline Length = 190 km
North (mm)
East (mm)
Up (mm)
WRMS = 1.4 mm
WRMS = 1.9 mm
WRMS = 4.7 mm
20
10
0
-10
-20
93.65
93.70
93.75
93.80
Date (Years)

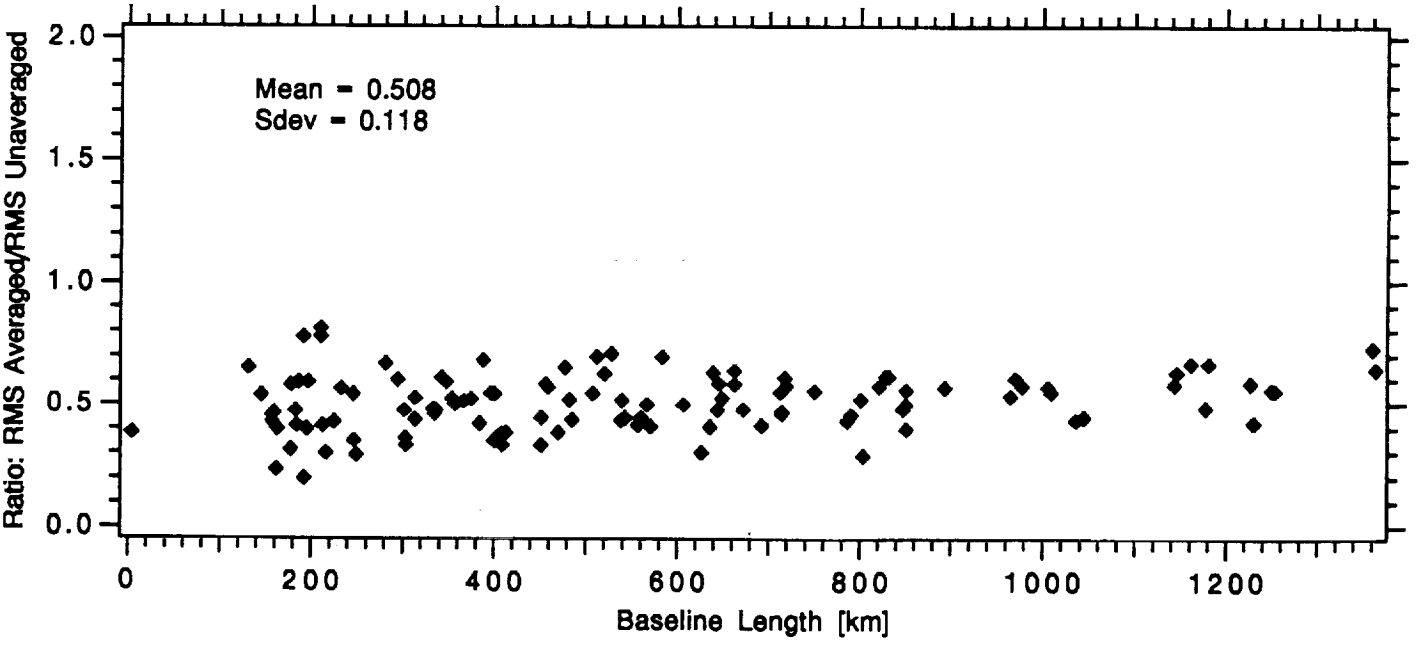

Karlstad - Umeå; Baseline Length = 560 km
North (mm)
East (mm)
Up (mm)
WRMS = 2.0 mm
WRMS = 2.5 mm
WRMS = 5.5 mm
20
10
0
-10
-20
93.65
93.70
93.75
93.80
Date (Years)

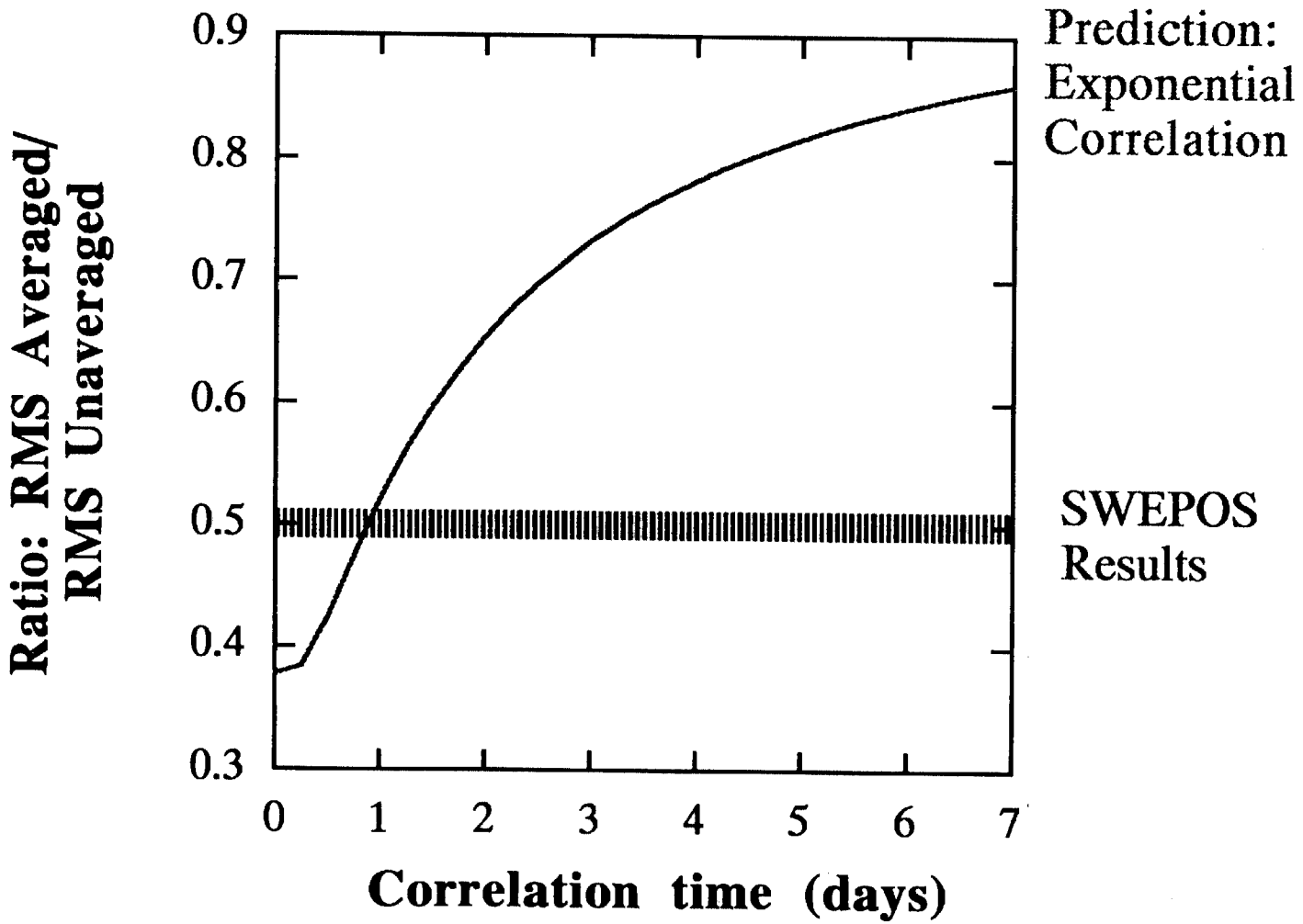
Correlation Study

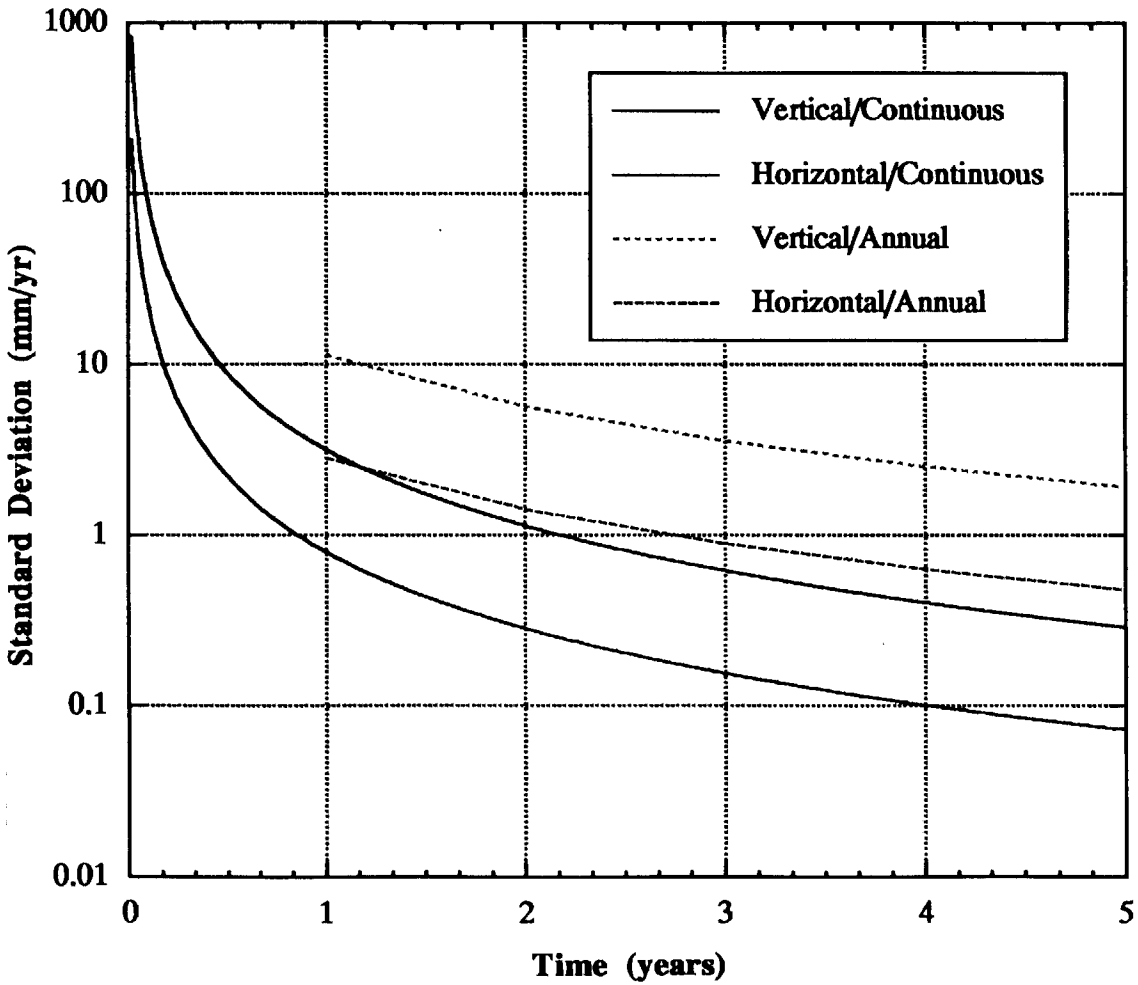
- Using limited data (~60 days), we attempt to obtain measure of temporal correlations
- Method: Group observations into weeks, determine weekly averages
- If errors are uncorrelated day-to-day, errors in weekly averages should be $1/\sqrt{7}$ (0.378) times smaller
- Model for correlations: $r(\Delta t) = \exp[-|\Delta t| / \tau]$
- This model can be used to predict precision of averaged values for different values of τ
- Using ratio of RMS scatters of averaged values to RMS scatters of unaveraged values, we can estimate τ
- Results: $\tau \approx 1$ day ($r < 1\%$ after 5 days)


Daily Solutions (Unaverged)
Weekly Solutions (Averaged)
1.8 + 1.0 ppb
0.8 + 0.8 ppb
RMS of Baseline Length [mm]
Baseline Length [km]
0
1
2
3
4
5
6
0
200
400
600
800
1000
1200


RMS Weekly Solutions [mm]
RMS Daily Solution [mm]
0
1
2
3
4
5
6


Mean = 0.508
Sdev = 0.118
Ratio: RMS Averaged/RMS Unaveraged
Baseline Length [km]
0.0
0.5
1.0
1.5
2.0
0
200
400
600
800
1000
1200


Ratio: RMS Averaged/
RMS Unaveraged
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
1
2
3
4
5
6
7
Correlation time (days)
Prediction:
Exponential
Correlation
SWEPOS
Results


1000
100
10
1
0.1
0.01
0
1
2
3
4
5
Standard Deviation (mm/yr)
Time (years)
Vertical/Continuous
Horizontal/Continuous
Vertical/Annual
Horizontal/Annual

Conclusions and Future Work

The results show that the network can be used in geophysical applications such as the DOSE investigation on Postglacial rebound

Smithsonian Astrophysical Observatory
Onsala Space Observatory
National Land Survey of Sweden
University of Toronto

Areas of research

Atmospheric Loading

Troposphere

Ionosphere

Multipath

Anti-Spoofing (AS)

Correlations (power spectra, etc.)